5E Model for Integrated STEM Education

Educator Effectiveness Academy

STEM Follow-Up Webinar

December 2011

Presenters

Donna Clem
   MSDE STEM Coordinator

Raquel H. Marshall
   MSDE STEM Specialist

Rick Marquart
   MSDE Professional Development

Educator Effectiveness Academy 2011 STEM Goals

- To provide participants an awareness of the necessity to prepare students to enter the national and global STEM workforce.

- To engage participants in activities focused on the why, what, and how of Maryland STEM Education.

STEM Fall Webinar Format

- Asynchronous Delivery

- Intended Audience: STEM 2011 Participants

- Team Discussion Icon

  - Pause the webinar to allow for team discussion or activity.
  - Upon completion, re-start the webinar.
  - Webinar Capture Sheet

Educator Effectiveness Academy Fall 2011 Webinar
Capture Sheet

Webinar Format
- Asynchronous Delivery
- Intended Audience: STEM 2011 Participants
- Team Discussion Breaks

| Discussion Break	Comment
#1 Engagement	
#2 Exploration	
#3 Explanation	
#4 Elaboration / Extension	
#5 Evaluation	

STEM Fall Webinar Outcomes

Participants will…

- view the definition of STEM Education.

- review the 5E Model for Integrated STEM Education.

- develop a plan for sharing this professional development with their STEM Professional Learning Communities and school faculty.
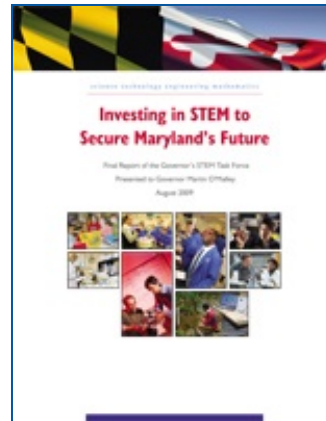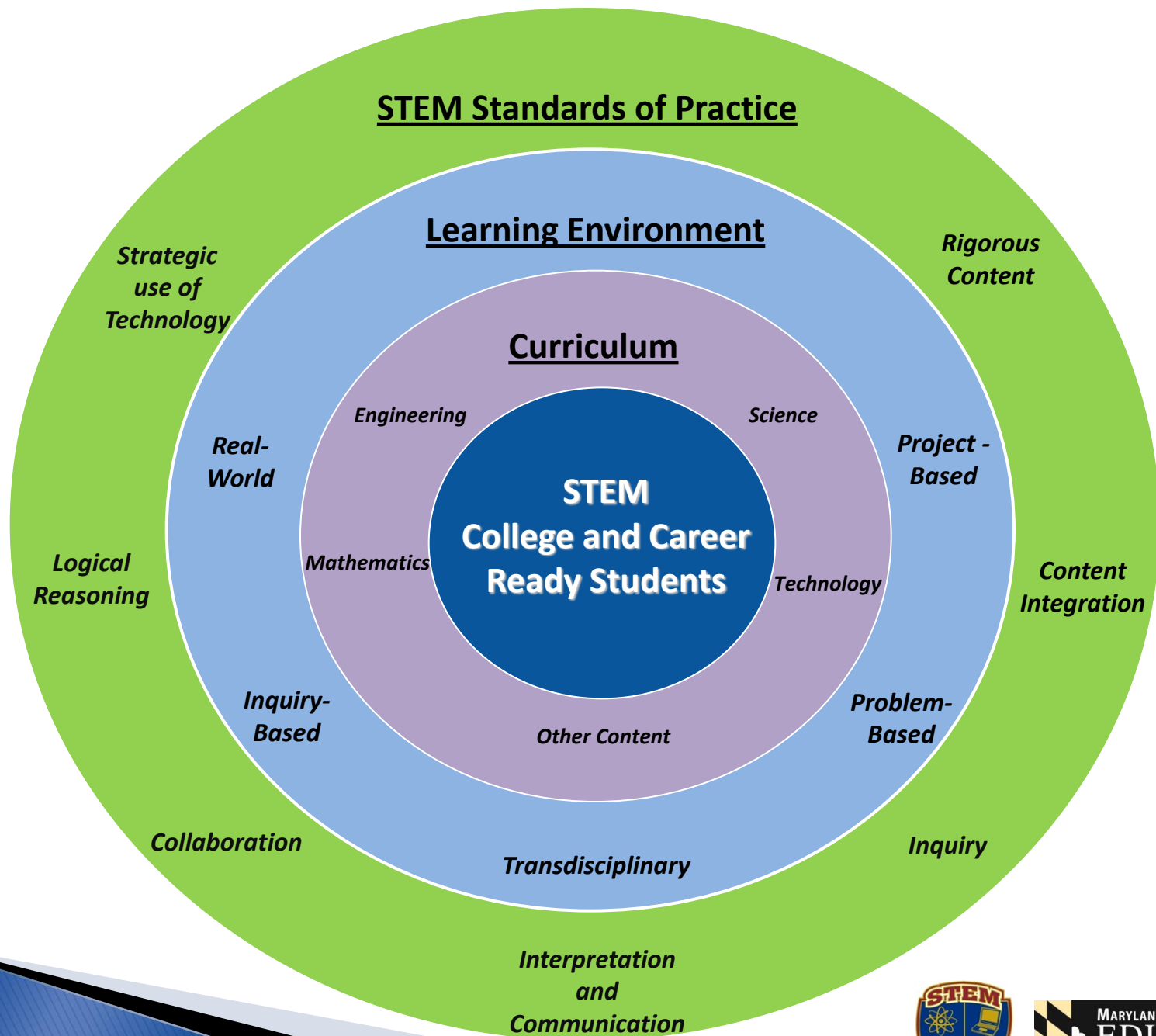
STEM Education in Maryland

MSDE STEM Education Definition

STEM education is an approach to teaching and learning that integrates the content and skills of science, technology, engineering, and mathematics. STEM Standards of Practice guide STEM instruction by defining the combination of behaviors, integrated with STEM content, which is expected of a proficient STEM student. These behaviors include engagement in inquiry, logical reasoning, collaboration, and investigation.

The goal of STEM education is to prepare students for post-secondary study and the 21st century workforce.
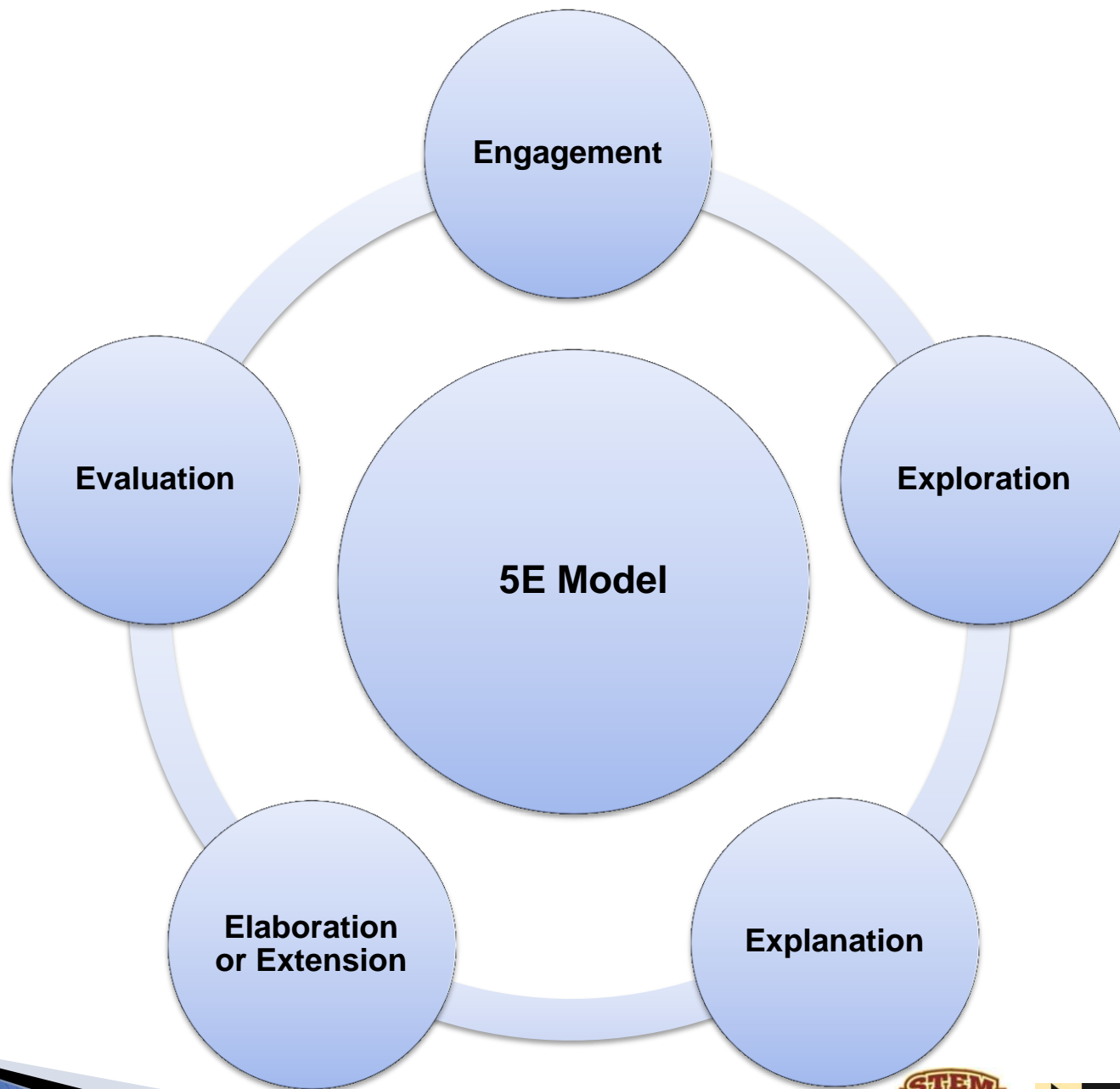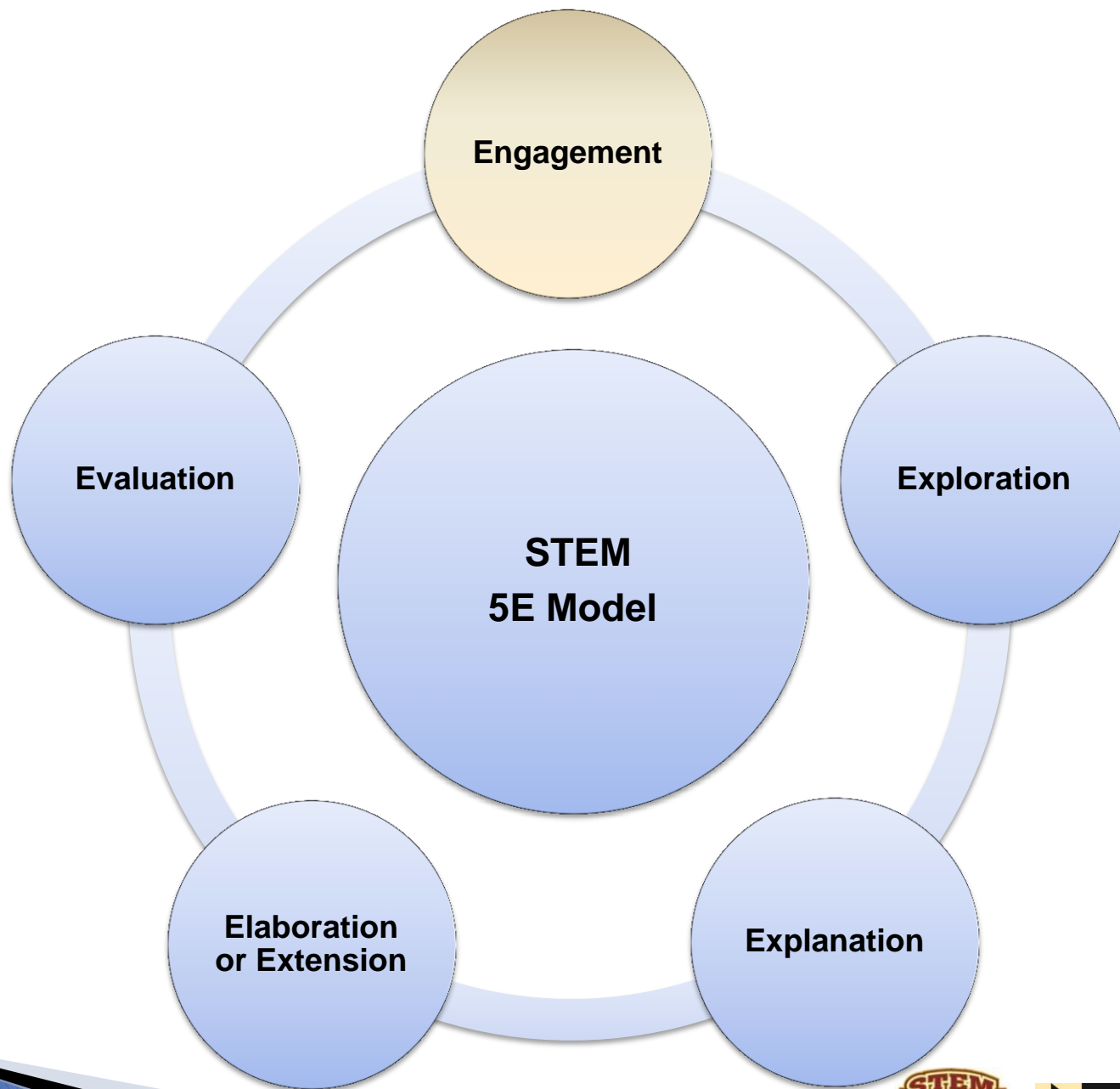
STEM Standards of Practice

Learning Environment

Curriculum

Strategic use of Technology

Rigorous Content

Real-World

Engineering

Science

Project - Based

Logical Reasoning

Mathematics

STEM College and Career Ready Students

Technology

Content Integration

Inquiry-Based

Other Content

Problem-Based

Collaboration

Transdisciplinary

Inquiry

Interpretation and Communication

The 5E Model

Engagment

The activities in this phase are designed to capture the student's attention, stimulate their thinking, and help them access prior knowledge.

Engagement in STEM Education

- Teacher or student poses a real world problem, complex question, or global issue.
- Students brainstorm potential solutions or construct explanations.

Example: Health – Sports Safety

http://www.youtube.com/watch?v=Q-I4h0s2jnU&feature=related

Engagement in STEM Education

- What types of forces are absorbed by a helmet during a collision like this?
- What about the medical concern of concussions occurring during a football collision?

Team Discussion/Activity
Break 1

Team Facilitator Notes

▸ *Discuss: **List three or more engagement activities that you could use with your students.***

▸ *Record the ideas on the Webinar Capture Sheet.*

▸ *Pause the webinar. Return upon completion of the discussion activity.*

STEM Engagement

Teacher

▸ Poses potential problems

▸ Raises questions to reveal discrepancies

▸ Elicits responses

▸ Identifies a real life problem, issue, or challenge to explore further

Student

▸ Asks relevant questions

▸ Develops a need to know

▸ Access prior knowledge

▸ Identifies a real life problem, issue, or challenge to explore further

Adapted from Llewellyn, D. (2005)

MARYLAND STATE DEPARTMENT OF
EDUCATION
Achievement Matters Most
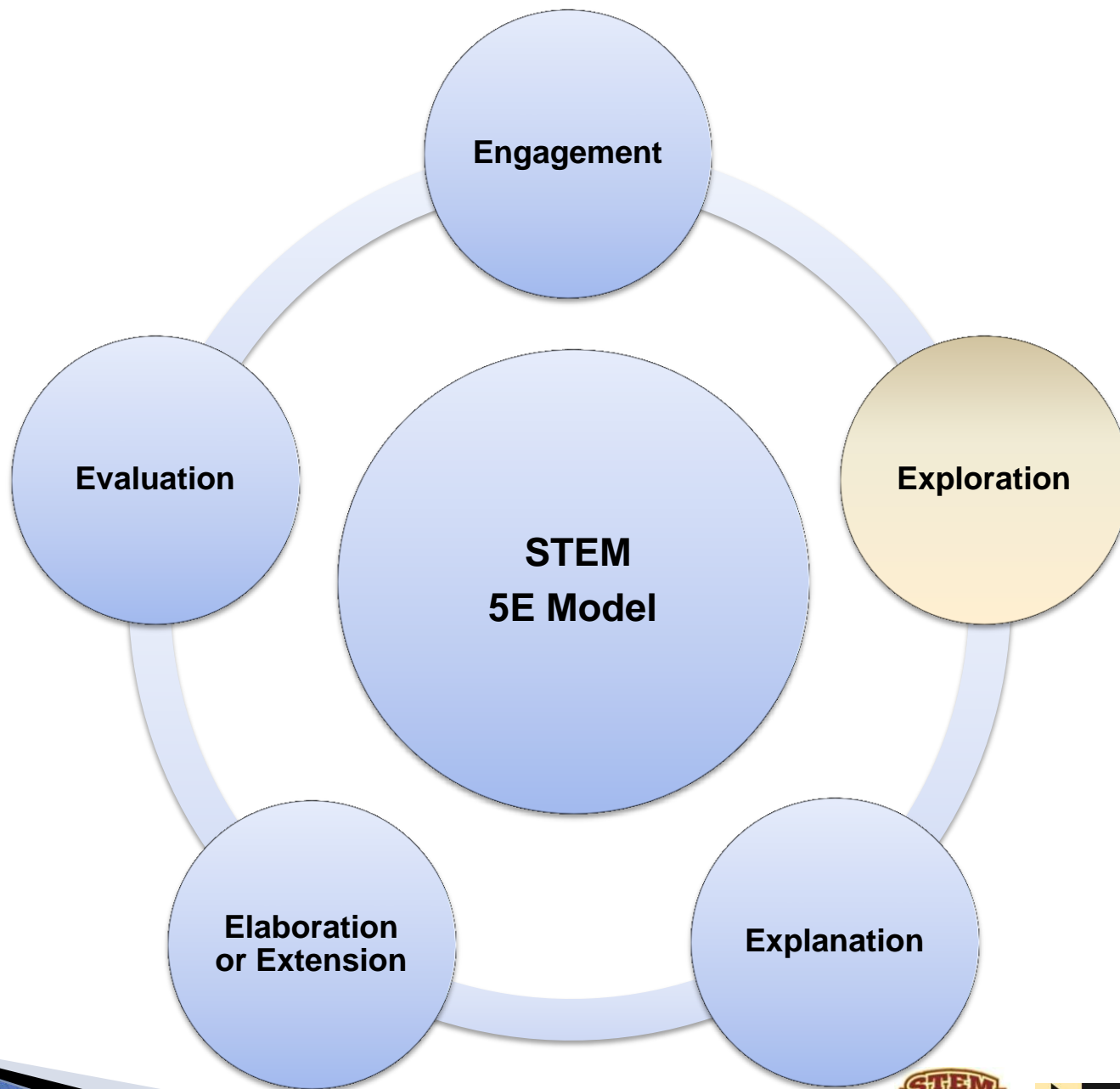
Exploration

Students are given time to think, plan, investigate, and organize collected information. For example, students may perform experiments, conduct research, and design test models or prototypes.

Exploration in STEM Education

Students explore and make connections between
- Science
- Technology
- Engineering
- Mathematics
- Other disciplines

Students select and apply the appropriate systematic approaches to answer complex questions, investigate global issues, and to develop solutions for challenges and for real world problems.

Team Discussion/Activity

Break 2

▸ *Discuss: **What strategies, tools, and/or resources would support the exploration of a complex question, issue, or challenge?***

▸ *Record the comments on the Webinar Capture Sheet.*

▸ *Pause the webinar. Return upon completion of the discussion activity.*
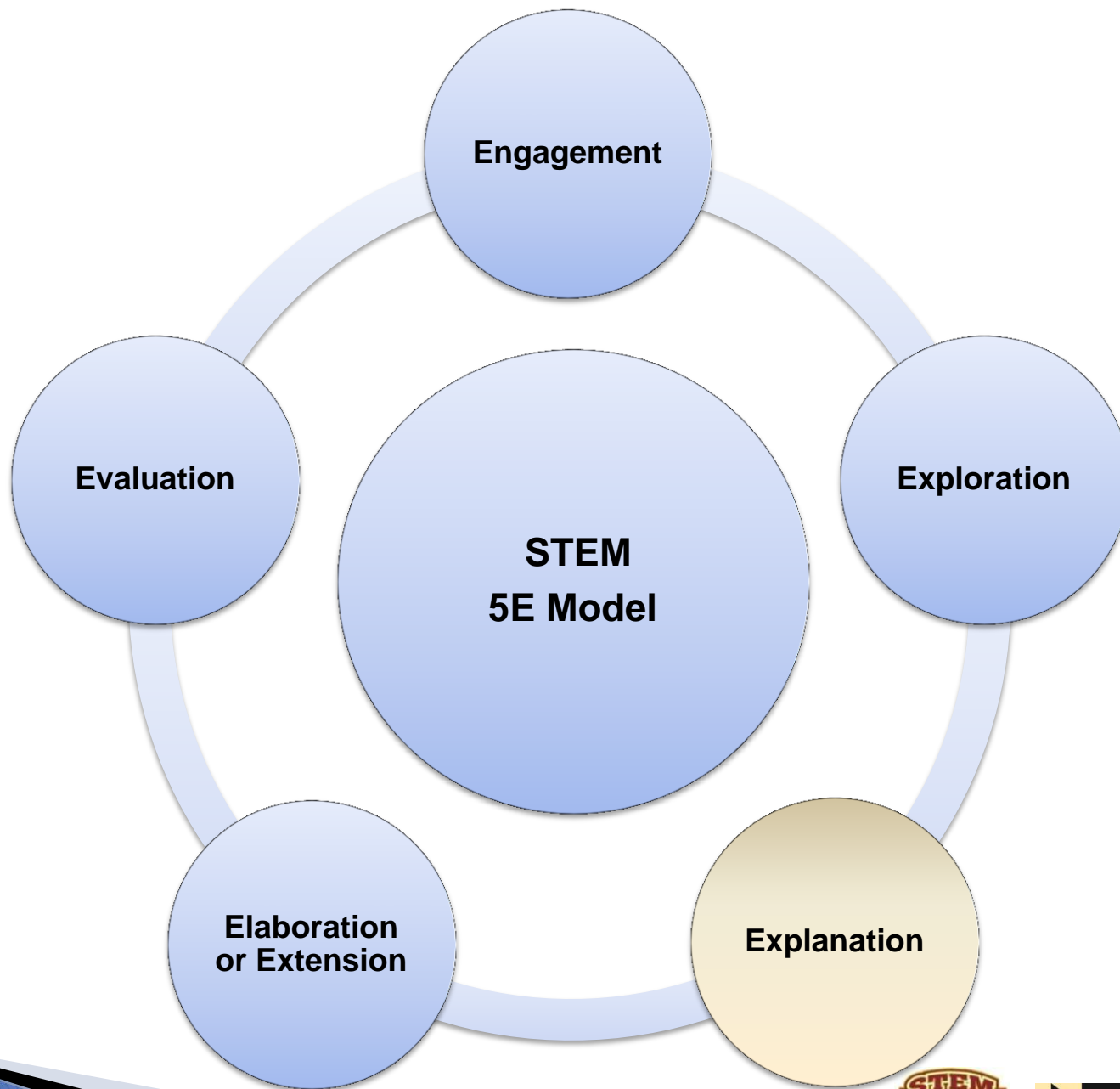
STEM Exploration

Teacher

▸ Asks probing questions related to STEM content and processes

▸ Provides time for students to think through the STEM disciplines related to a real world problem or issue

Student

▸ Researches various content and processes

▸ Conducts experiments, plans investigations, and designs models
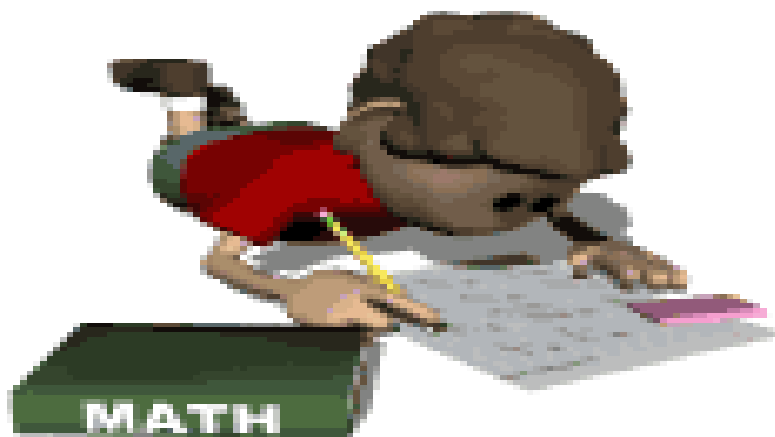
▸ Records observations

Adapted from Llewellyn, D. (2005)

Explanation

Students are involved in an analysis of their exploration. They clarify understandings discovered and communicate in various ways.

Explanation in STEM Education

Students
- Analyze and interpret data
- Communicate understandings and possible solutions
- Use technology appropriately for analysis and communication

Team Discussion/Activity
Break 3

▸ *Discuss:* ***What types of analysis and communication methods or tools would you expect students to use to show evidence of their comprehension of their exploration?***

▸ *Record the comments on the Webinar Capture Sheet.*

▸ *Pause the webinar. Return upon completion of the discussion activity.*

STEM Explanation

Teacher

▸ Encourages students to collaborate to explain concepts

▸ Asks for justification (evidence) and clarification

▸ Uses students' previous experiences as the basis for explaining concepts

Student

▸ Listens critically to and questions others' explanations

▸ Uses recorded observations in explanations

▸ Generates graphs, charts, reports, diagrams, and sketches

Adapted from Llewellyn, D. (2005)
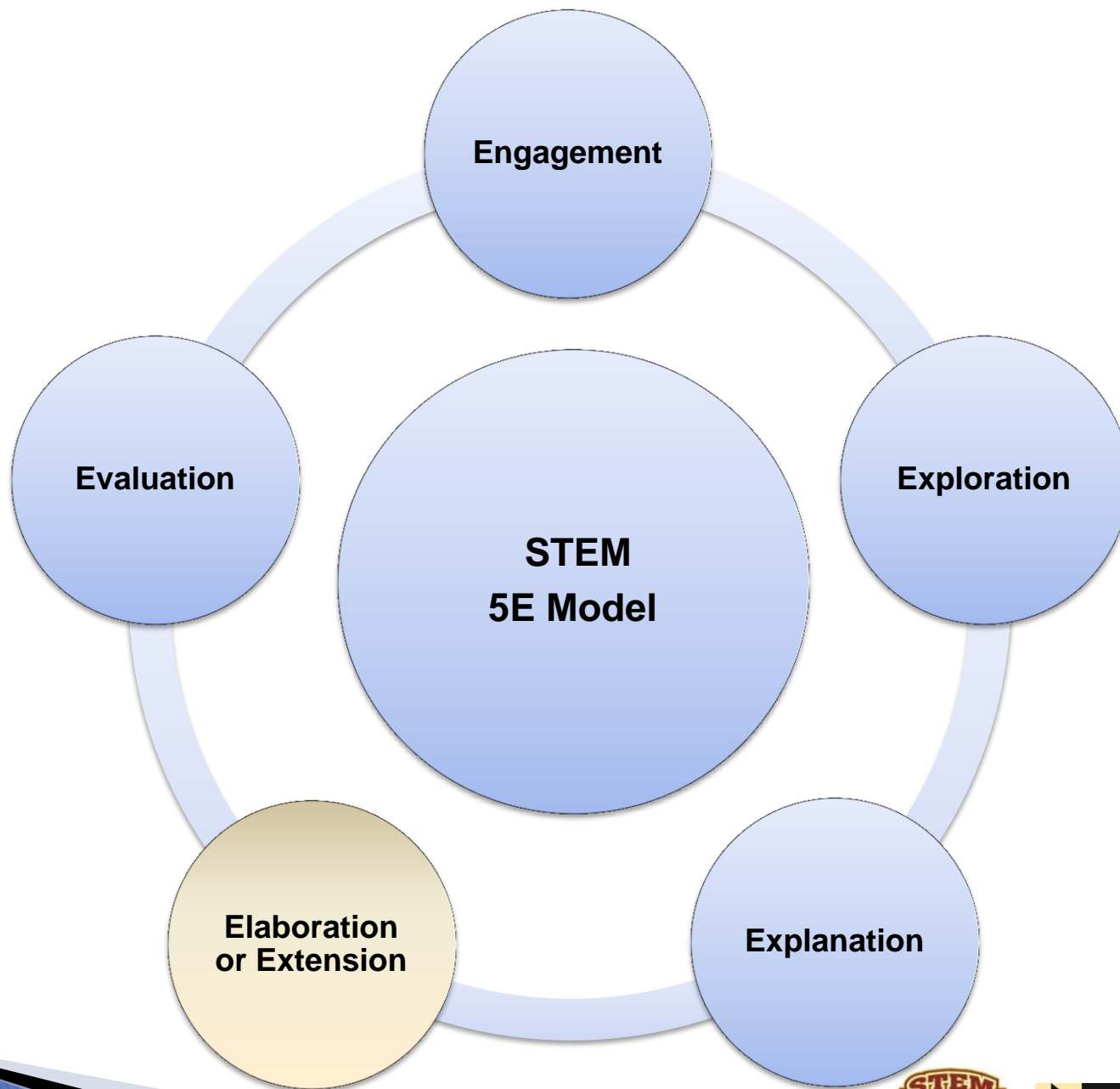
Elaboration or Extension

Students are given the opportunity to expand and solidify their understanding of the concept.

Elaboration in STEM Education

Students

- Refine solutions, prototypes, and/or models
- Modify experimental procedures for further exploration
- Identify and analyze connections to STEM careers

Team Discussion/Activity
Break 4

▸ *Discuss: **What strategies could be used to explore related STEM careers?***

▸ *Record the comments on the Webinar Capture Sheet.*

▸ *Pause the webinar. Return upon completion of the discussion activity.*

STEM Elaboration

Teacher

▸ Encourages students to apply learned concepts and skills in new situations

▸ Reminds the students that there are multiple solutions to real world problems

▸ Encourages perseverance when challenges occur

Student

▸ Applies learned concepts and skills in new situations

▸ Uses previous information to ask additional relevant questions

▸ Draws connections between STEM careers and their project work

Adapted from Llewellyn, D. (2005)
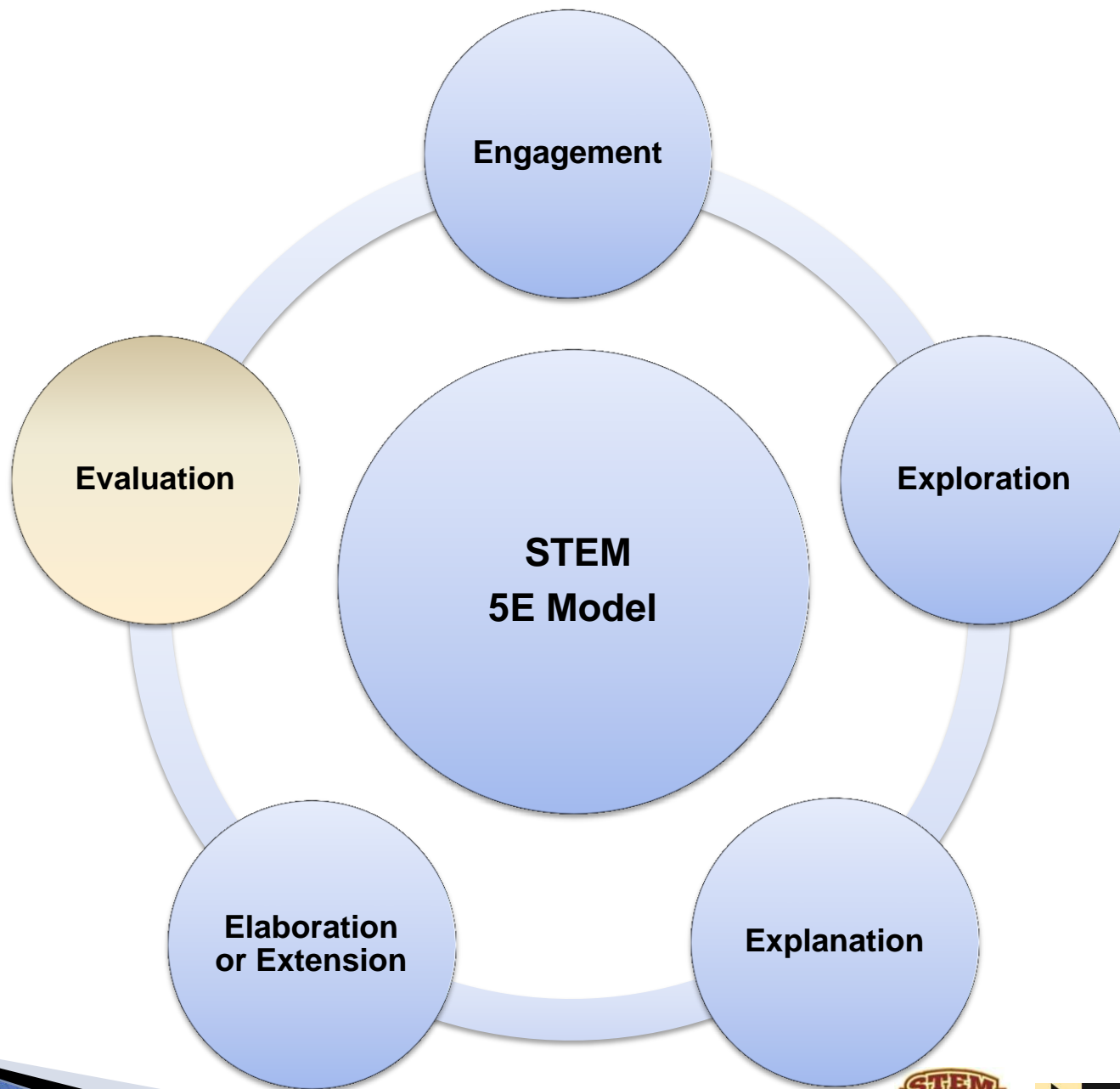
Evaluation

Evaluation occurs throughout the 5E Model. Rubrics developed by teachers and students target what students must know and do.

Evaluation in STEM Educaton

Students

- Reflect on their solutions to the complex question, issue, challenge or problem
- Participate in peer reviews
- Demonstrate understanding through performance-based tasks

Team Discussion/Activity

Break 5

▸ *Discuss: **What are some examples of performance-based tasks that could be used to evaluate a STEM application?***

▸ *Record the comments on the Webinar Capture Sheet.*

▸ *Pause the webinar. Return upon completion of the discussion activity.*

MARYLAND STATE DEPARTMENT OF
EDUCATION
Achievement Matters Most

STEM Evaluation

Teacher

▶ Assesses students' knowledge and/or skills

▶ Looks for evidence that the student demonstrates understanding

▶ Asks open-ended questions

Student

▶ Answers open-ended questions

▶ Evaluates his or her own progress and knowledge

▶ Asks related questions that would encourage future exploration

Adapted from Llewellyn, D. (2005)
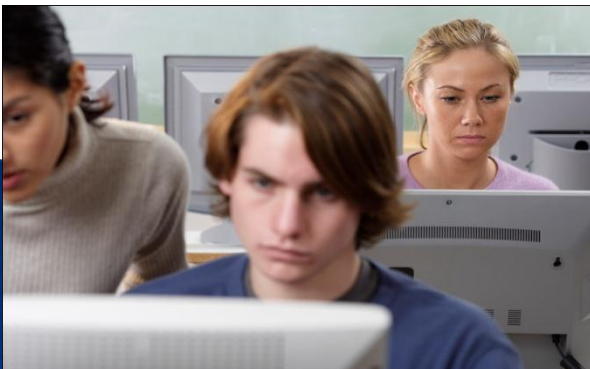
...tudies

Health... ...tion

Art

5E Model for Integrated STEM Education

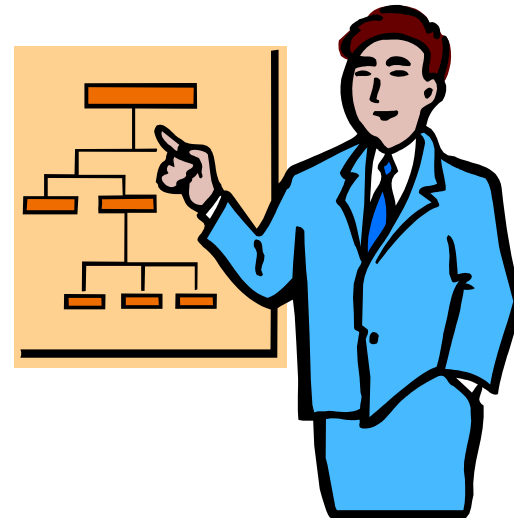## IS APPLICABLE IN ALL CONTENT AREAS

Science

Mathematics

Technology

Suggested Webinar Extension Activity

Develop a plan for sharing this professional development with your STEM Professional Learning Communities and school staff.

Next Steps

- Spring STEM Webinar

- 2012 Educator Effectiveness Academies

Thank You

Merci

Gracias

Donna Clem
Coordinator of STEM Initiatives
Maryland State Department of Education
200 West Baltimore Street
Baltimore, MD 21201
Phone: 410 767 0441
dclem@msde.state.md.us

References

Llewellyn, D. (2005). *Teaching High School Science Through Inquiry*. California: Corwin Press.

YouTube. (2009, January 11). *Ray Lewis Hits Ahmard Hall*. Retrieved December 15, 2011, from http://www.youtube.com/watch?v=Q-I4h0s2jnU&feature=related